
The Secret Garden
CEO
Shruthi Rao

The Secret Garden

Shruthi Rao

Dedicated to two teachers:

Mr A S Negi, who brought us
closer to nature,
&
Mrs Sudha Iyengar, who inspired us
in more ways than she knows.

- Team NSI

Spring

All around me, the trees are in bloom. Wherever you look, there are splashes of colour—the bright yellow of the Tabebuia and Amaltas, the fierce red of the Gulmohar, the Silk Cotton and Flame of the Forest, the mauve of the Jacaranda, the purple of Pride of India, the pink of Bauhinia, and the white of the tiny flowers of Neem and Pongamia.

Bees buzz around the flowers, and birds sing on branches.

I am a Peepal tree. I grow next to the flowering trees, spread my branches, and reach for the sky. My roots reach deep into the ground, and I stand, strong and tall. My shiny, heart-shaped leaves flutter in the slightest breeze. When my leaves catch the sunlight, they shimmer, and I feel like I'm wearing the most resplendent brocade that ever emerged from the looms of Banaras.

The Peepal is a kind of fig plant (also known as *Ficus*). There are many kinds of fig trees, like the Banyan and the Goolar.

Where Are the Flowers?

"Where are your flowers?" The other trees ask me, shaking their own pretty flowers at me. "Here, look at ours. Where are yours?"

"Where are your flowers?" chirp the birds.

"Whe-ere? Whe-ere?" asks the Koel.

"Can't see! Can't see!" says the Tailorbird.

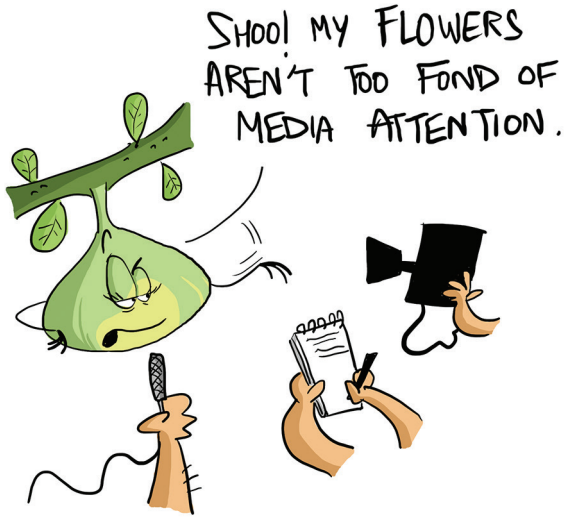
"Doesn't the Peepal bloom at all?" you probably wonder, standing under me.

Of course I bloom. Trees need flowers to make new seeds, which in turn will grow into new trees.

So where are my flowers?

Ah! That, child, is my little secret. Come close, and I'll bend down and whisper it in your ear.

My flowers are hidden in my secret garden, which nobody can see. And no, you cannot go in there. Only a very special friend can enter the garden.



Peepal

Banyan

The figs (family: Moraceae): They can grow up to 30 metres, as tall as the ninth floor of an apartment block, and can live for hundreds of years. Fig trees grow everywhere, and can be found in cities, villages, rainforests, deserts and grasslands. They even grow on rocks and cracks in buildings and even on other trees. Fig plants can take a variety of forms such as, trees, stranglers, vines and shrubs.

Goolar

My Friend and I

I have many friends. The birds that come to eat my fruit, and to nest on me. The snakes that slither around, looking to eat the birds. The squirrels, and the monkeys. And of course, the other trees around me.

But one of these friends is special to me. She is a Fig-wasp. Her name is Kanaja.

Kanaja and I are very different from each other. I can grow very tall, as tall as a building. And I can live for decades, even centuries. But Kanaja is so tiny that she can easily fit onto a pinhead. And she lives only for a day or two.

But we have a special relationship. We need each other to help our babies grow. In fact, our babies grow together in my secret garden!

The pollinator Fig-wasp (family: Agaonidae): This creature is just about 1-1.5 mm, about the size of the full-stop at th end of this sentence. The adult wasp has a very short life, and lives only for a day or two.

A Unique Partnership

You're still here! Oh, you want to know how exactly Kanaja and I help each other. Okay, sit down, and I'll tell you. Yes, right here on the ground, in my shade. Make yourself comfortable. Yes, you may lean on my trunk.

How do we help each other? Kanaja pollinates my flowers for me. She brings pollen from other Peepal trees, delivers it to my flowers, and helps me make seeds. And she carries pollen from my flowers, and takes it to other Peepal trees.

In return for her help, I let Kanaja lay her eggs in the flowers in my secret garden, and I give her babies food and a safe place to grow up.

There are over 750 species (types) of Ficus. And each fig tree has a special wasp friend. That means, for all the 750 types of fig trees, there are 750 different kinds of Fig-wasps! The Peepal's partner is the Fig-wasp called *Blastophaga quadraticeps*.

This alliance between two partners cooperating with each other is known as Mutualism.

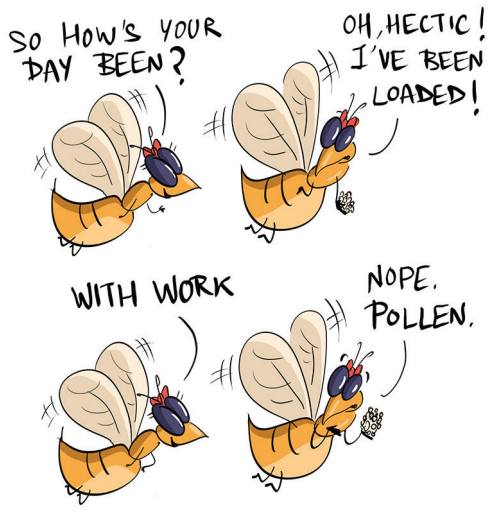
Mutualisms are very, very special links between species, where two interacting species benefit mutually. Common examples of mutualism are relationships between honeybees and flowers, birds and fruits, ants and aphids. Fig trees are pollinated by wasps, and wasps get a home in the fig fruit to nurture their young. The lives of the fig tree and the Fig-wasp are very closely wound and they cannot survive without each other.

Finding Each Other

The story of Kanaja starts in a secret garden on another Peepal tree. As soon as she is born, she stuffs the pockets in her chest with pollen from the flowers of that garden. She then sets out on her journey, and comes looking for me.

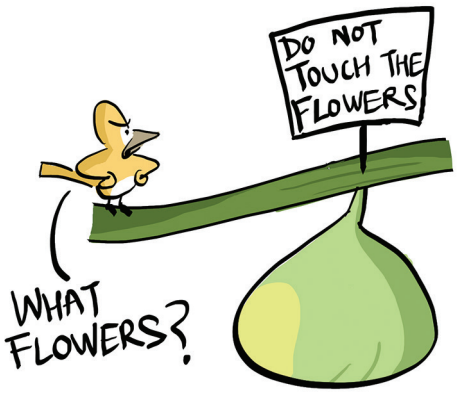
She has pockets on the body called pollen pockets where the pollen is kept. The pockets are in the thorax of the wasp. The thorax is situated between the head and abdomen/stomach.

Her tiny wings beat, and she flies non-stop, sometimes on her own, sometimes carried by the wind. Sometimes she has to fly tens of kilometres before she finds me. She sees and smells many trees along the way. Some of them are my cousins, like the Banyan, but Kanaja isn't interested in them. She is seeking my smell—the unique fragrance that only Peepal flowers give out, which will tell her that I am what she is looking for.

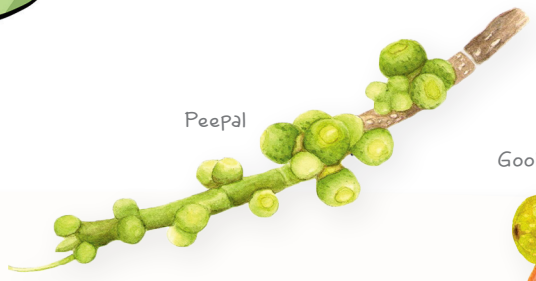


The mutualism between the fig and Fig-wasp started 90 million years ago — long before humans evolved. All living things evolve. That means that by a very slow process, the ones that can adjust better to the conditions around them leave more babies behind. Evolution ends up adding tiny changes to all living things over eons and eons of time. So each time a fig or a Fig-wasp evolved for some reason, the fig tree also evolved to suit the changes in its partner.

Finally she catches my scent, and she flies towards me. I'm happy; I've been waiting for her. I flutter my leaves and beckon to her. She can smell my flowers even more strongly now, but she can't get to them yet. That is because my flowers are not open to the world, you see, but are enclosed within a small structure called a syconium, which is just a cluster of flowers. My syconia are green, and grow attached to my branches and stems, mostly in pairs. Compared to how huge I am, my syconia are tiny, the size of peas. To you, they might look like unripe fruits.



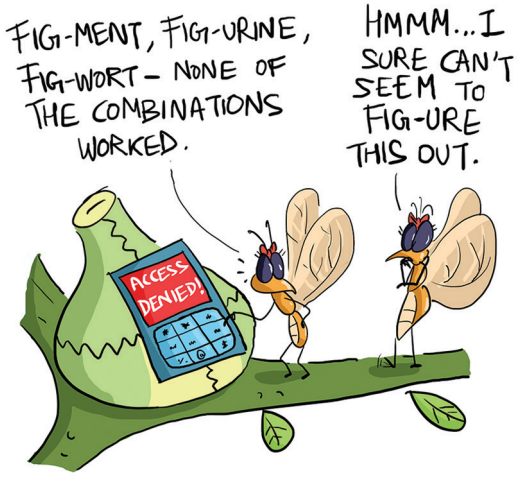
These syconia are my secret gardens. Now you know why you cannot see my flowers. You do see the gardens, but probably think they are my fruits! Inside each garden, there are a 100 to 150 white flowers, and it is these flowers that Kanaja wants to reach.



Syconia (plural of syconium): They could be green or white. They could hang from branches, grow on trunks or between leaves. Depending on the type of fig plant, they could be of different sizes — from the size of a pea to the size of a tomato. Inside each syconium are tens to hundreds to thousands of flowers that are mostly white, but might sometimes be pink, pale yellow or even bright red.

Entering the Secret Garden

Like I told you before, not everybody can enter the garden. Only Kanaja can. But how? Well, every secret garden has a secret gate! Each syconium has a little opening called an ostiole. It is located at the top and it is the gate to the secret garden. Although there are many species of wasps flying about, only Kanaja can go through the gate of my garden to reach the flowers. This is because only she has the correct sized head that can help her push through the garden gate.



To squeeze through, Kanaja needs to get rid of her wings, and parts of her antennae. And no, leaving them behind doesn't hurt her. She enters and walks all over the flowers. On many of the flowers, she spreads the pollen she has been carrying, and in some of them, she lays her eggs.

Soon after Kanaja enters, the garden gate closes forever, and no other wasp can get in.

Kanaja is tired. She has flown a long way to find my secret garden, struggled to get in, and spent the last of her strength in spreading pollen and laying eggs. She lies down and goes to sleep forever, trusting me to look after her babies.

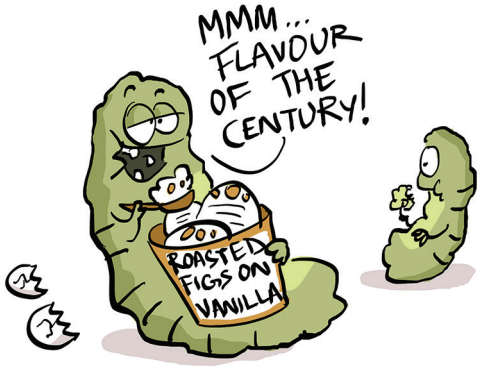
Nurturing Babies

Kanaja's work is done. She has laid her eggs. She has brought pollen with her, and pollinated my flowers. Most of these flowers will become seeds, my little Peepal babies.

So now, it is my turn to return Kanaja's favour. I have to live up to her trust, and look after her babies.

My babies (seeds) and Kanaja's babies (larvae) develop side by side inside the flowers in my secret garden. Each flower contains either a seed or a wasp baby.

My secret garden is a safe place for the babies to grow. Its wall is thick, and protects the babies. Outside, it might be too cold, or too hot. There might be rain, winds, storms. Parasites, and predators like ants, praying mantises, spiders and dragonflies might come around, looking to get into the garden. But nothing bothers the babies. They sleep in the garden, safe and secure.



The flowers that carry larvae are round, and are called galls. The galls contain food on which the wasp larvae feed.

It takes about a month for both the seeds and larvae to develop fully into mature seeds and adult wasps like Kanaja.

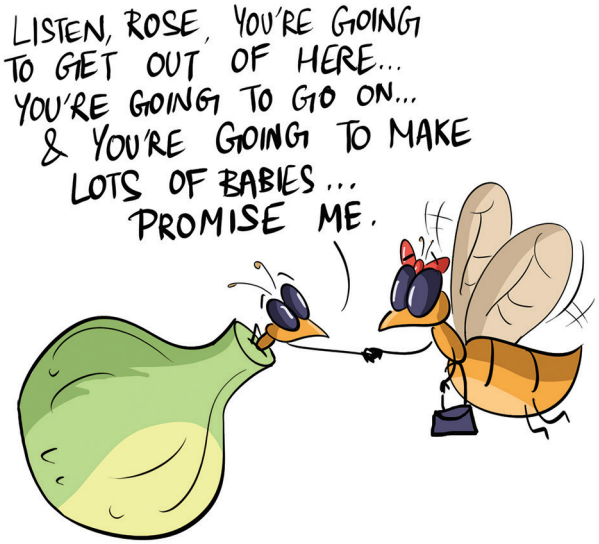
Flying Free to Find a New Garden

Now Kanaja's next generation swings into action! Once the babies develop fully, they emerge from the galls inside my secret garden. Kanaja's daughters collect pollen from the flowers that are clustered at the top of the garden, forming a crown near the garden gate. They pack the pollen into their pollen pockets. They are now ready to fly out.

Peepal syconium section

But the garden gate is closed! So how will they get out? Kanaja's sons get to work. They have strong jaws with which they chew open a window in the thick wall of the garden, and then Kanaja's daughters, carrying pollen, fly out through these windows.

Now it is time for Kanaja's daughters to go looking for the scent of another Peepal tree, and enter one of its secret gardens, and continue the cycle!



Always Being There for Each Other

Kanaja and my other little wasp friends are tiny and delicate. They don't live for a long time, but die within a couple of days after leaving their home garden. And that is why we Peepals always need to have gardens ready for them as they arrive with their load of pollen and eggs. And that is why I produce secret gardens throughout the year. And if I don't have a garden ready, another Peepal somewhere around has a garden all set. So whenever a friendly Fig-wasp is in the neighbourhood, one of us is waiting to receive her!

Asynchronous fruiting – This means that fig trees of the same species do not follow a seasonal pattern of fruiting. Each tree flowers and fruits at a different time of the year. That also means that figs are available all through the year.

Are Secret Gardens Really Safe?

I do my best to keep the gardens safe. The garden wall is thick, and it has a bitter, milky juice which makes it unpleasant to eat, and this keeps at bay birds or animals which might otherwise eat it. Yet, my gardens are not always completely safe.

There are other wasps that do not help in pollinating my garden, but use the garden to lay their own eggs. There is, for instance, Copper. She is a Parasite Wasp. She doesn't have the key to my garden—so she has devised another way to get in—through the walls. Copper has a long, needle-like tube on her abdomen, which she uses to pierce the garden wall, much like how the needle of a syringe plunges into you when you are given an injection. She then lays her eggs in my garden. Her babies use up the food which is meant for Kanaja's babies and mine.

But that is not all. There are tinier organisms which also use my garden uninvited. These are worms and mites. They take a free ride with Kanaja, enter the garden along with her, and use the garden as a nursery for their babies. These babies like to eat male flowers, and so if a lot of these worms and mites end up inside me, I won't have much pollen left to send to other trees.

But only a part of my pollen and flowers are wasted this way and I still manage to save enough. It is a natural process, and there is nothing to worry about—in the larger scheme of things, everything turns out fine.

A Delicate Balance

So now do you see why Kanaja is special to me? Every living thing needs to make babies, so that our species can continue to live on, and Kanaja and I need each other's help for this.

So, what would happen if all Fig-wasps become extinct? There will be nobody to carry my pollen to other Peepal trees, and gradually, all Peepal trees will become extinct too. And in the same way, if all Peepals are cut down, there will be no safe nurseries for the wasp's babies, and so wasps will also become extinct.

The world is warming up, and temperatures are rising all over the world. This might lead to some of these delicate wasps dying out. If a Fig-wasp goes extinct, there is no more pollination for the fig plant, which means no more seeds — and no more plants.

Also, due to deforestation, if there is a shortage of fig plants, pollinator wasps will die before they can find their partner fig plant. And this shortage of fig plants and wasps may affect the entire ecosystem.

And Then the Party Begins...

After Kanaja's children leave the secret garden, the flowers which have been pollinated by Kanaja turn into seeds. In a few weeks, the secret garden ripens, changes colour from green to bright red or purple and becomes an edible fruit—the fig. Ripe figs give out a lovely scent that many birds and bats find irresistible.

Peepal figs (actual size)

Ripe

Unripe

Now, I'm ready to host a party! I don't need to send out invitations—the colour and the fragrance of my figs bring in hordes of visitors daily!

Green-pigeons, Mynas and Barbets, Bulbuls, Parakeets, fly to me. Monkeys arrive too, squabbling, and squirrels, nibbling. If I were in the forest, deer would have sauntered over to eat the fruits that have fallen on the ground. Next to me is Atthiamma, a Goolar tree. She also has ripe fig fruits festooned on her trunk like the beads on a hundred necklaces. The monkeys jump between her and me, cramming my fruit and hers into their greedy mouths. Elephants are fond of the fruits that Atthiamma's relatives in the forest produce. Although elephants rarely eat fruit from my Peepal relatives

in the forest (for ours are too small), they happily curl their trunks around the branches of common figs with ripe fruit and pop them straight into their cavernous mouths. Bats and civets also come along at night and divide their favours between me and Atthiamma.

There is jostling, and squawking, and pushing and gorging. I am tickled, and poked, jumped on and stamped on, but I love all the activity!

Fruit-eating creatures are called frugivores.

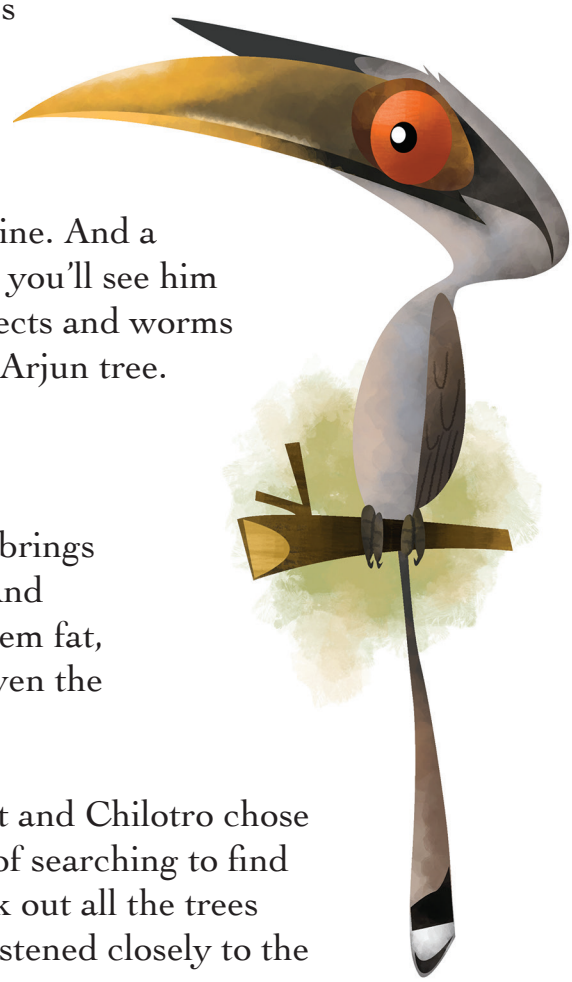
Anjeer is a kind of fig that humans eat, and is also known as the Common Fig.

You must have guessed that I have a reason to host this feast, other than the company, of course. I'll let you know. But first, let me introduce you to a lovely family—Mangat and Chilotro, and their chicks.

Mangat the Indian Grey Hornbill

Look above you, child—did you hear a flapping of wings? A screech? Can you see that brownish-grey bird flying, flapping its wings clumsily? What did you say—a dinosaur? That's quite right—the Indian Grey Hornbill does remind one of dinosaurs.

You might've seen pictures of colourful hornbills in books—but unlike those colourful hornbills, Mangat and Chilotro and their relatives are cement grey in colour. These Indian Grey Hornbills are the ones you're most likely to see in most parts of India, be it forests, villages or cities.



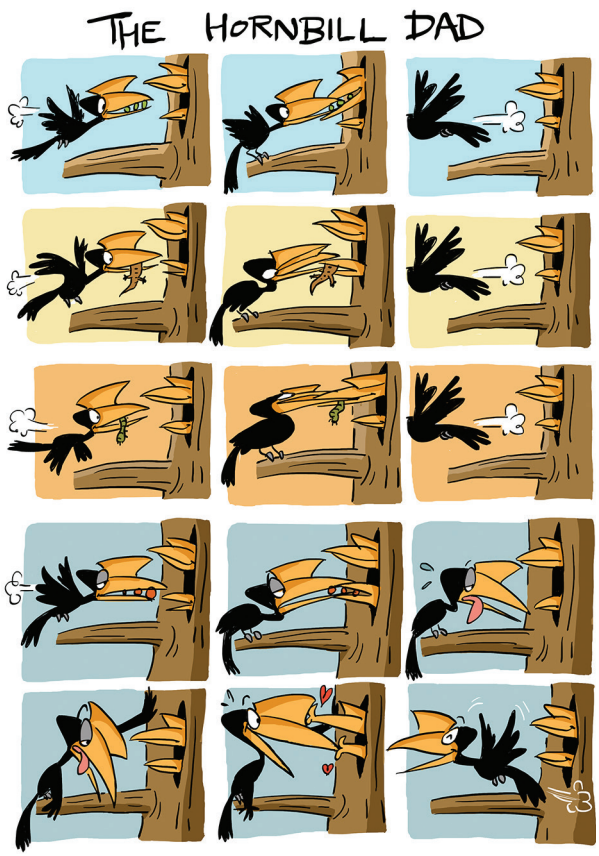
Mangat is a very good friend of mine. And a regular visitor. If you look closely, you'll see him flying to and fro, and bringing insects and worms and fruits to a small hollow in the Arjun tree.

Mangat is a hardworking fellow, providing for his family, which is cloistered in that little hollow. He brings them juicy fruits, especially figs. And when fruits are scarce, he feeds them fat, wriggling lizards, or sometimes, even the chicks of other birds!

Let me tell you about how Mangat and Chilotro chose their nest. It took them a full day of searching to find it. They flew near and far, to check out all the trees that they knew about. They also listened closely to the

conversations of other birds and bats who feed on fruit. Then, they spotted their friends—another hornbill couple flying towards the Arjun tree. So, Mangat and Chilotro decided to follow them.

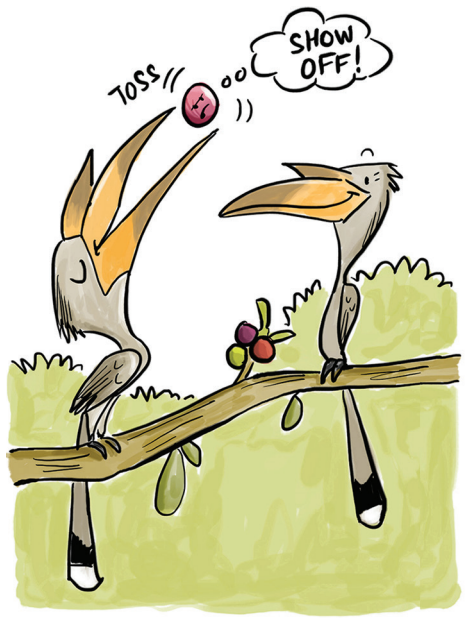
They found a suitable hollow that they chose as their home. Chilotro settled into this hollow, and except for a small opening, she sealed up the mouth of the hollow. For this, she used faeces, fruit-pulp, and some mud that Mangat brought her. This way, Chilotro and her future babies could stay safe from predators.



She then laid two eggs some weeks ago. Now the eggs have hatched. Their two little chicks are in there. Mangat brought food for first Chilotro, and after the eggs hatched, for the chicks too, and fed them through the small opening. After the chicks were a little older, Chilotro broke open the seal and flew out, while the chicks sealed the opening up again, from within. Now, both Mangat and Chilotro bring the chicks food. The chicks will stay in the hollow until they are ready to fly out.

Mangat and Chilotro are interesting creatures. They coo to each other all day, bending their heads in weird angles. Look, look at the way Mangat is twisting his head to look at you—he knows we're looking at him!

Mangat and Chilotro love my figs. Look at Mangat gorging on my fruit! First he picks a red fruit with the tip of his beak, and for some reason drops the fruit. Phat! My fruit falls under the shade of my own branches. Perhaps it wasn't ripe enough for him. Next he reaches out carefully to pick a dark purple fruit from a branch bearing hundreds of tiny fruit, and he swallows it. In a minute or two, he manages to find several fruit to feed on. He holds one of the ripe fruit at the tip of his beak, lifts his head up and tosses the fruit up in the air. And then, he reaches forward to catch it. I wonder if his acrobatics played a part in Chilotro choosing him as her mate. Look at her now, sitting close, watching him with admiration!

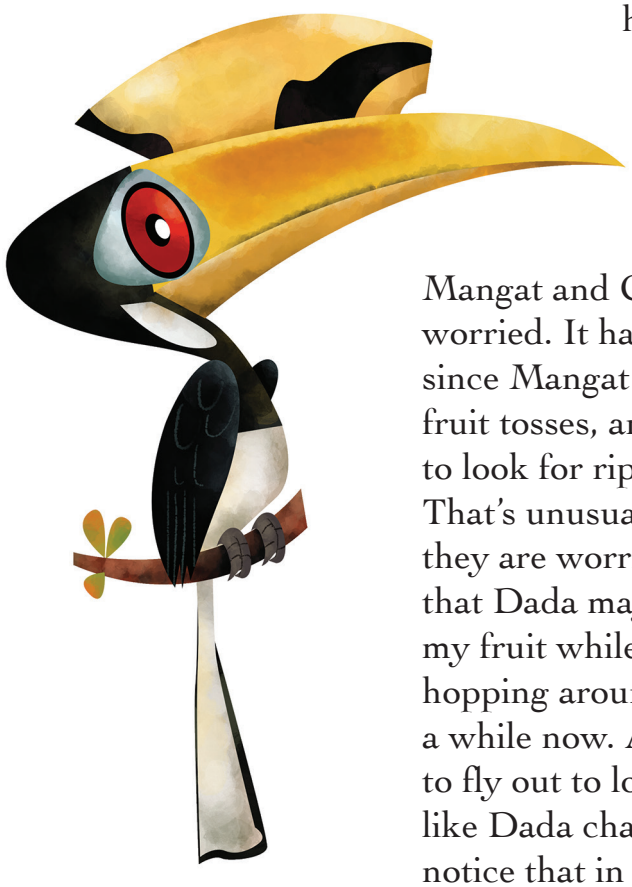


Hornbills love fruit, but fruiting trees are rare in cities and villages. It's especially hard to find fruit between January and April when very few of the other tree species bear fruit. Aren't they lucky that I am bearing fruit in April this year, when there is so very little for Mangat and Chilotro to eat?

When Mangat drops my fruit under the shade of my own branches, the seeds inside my fruit rarely germinate and grow. One reason for this is that there are a large number of seed-eating insects found in my shade. Even if my seeds survive insect attacks and fungal outbreaks which are common under my shade, they will rarely make it past the seedling stage. Cattle and people damage the seedlings that grow directly in my shade. The further my babies move from me, the more likely it is that they'll grow into tall, sturdy trees.

Dada the Oriental Pied Hornbill

What's that sound? Oh, look who's here! We have a rare visitor today—it's Dada, the Oriental Pied-Hornbill! Look at that big yellow beak... and what a casque! Dada loves my fruit. I haven't seen him in our town in a long time. He must have flown from very far, because my birdie friends tell me that he lives in a forest which is just outside our town. Dada probably heard about my ripening fruit from other birds who fly back and forth between the forest and our town.



Mangat and Chilotro suddenly look very worried. It has been over half an hour since Mangat did one of his acrobatic fruit tosses, and neither of them is trying to look for ripe fruit in my branches. That's unusual. Ah, I think it is Dada that they are worried about. They have heard that Dada may not like them feeding on my fruit while he is around. They've been hopping around on my top branches for a while now. And now they've decided to fly out to look for other food. It's not like Dada chased them out. But did you notice that in a few minutes after he came in, everyone else quietly slipped away? I have seen Dada's relatives chase out smaller birds and squirrels. The little creatures are quite wary of the powerful beaks of the Oriental Pied-Hornbills.

My Babies Find Homes

When Mangat and Chilotro fly away, they carry my fruit in their bellies. And with that, they carry my seeds away too. Their droppings contain my seeds. In this way, Mangat and Chilotro, scatter my seeds all around our town, and sometimes into nearby villages and forests that they move through, occasionally transporting my seeds several kilometres from where I stand. Isn't that amazing? Even though I stay rooted in my place for hundreds of years, my children are moved by my friends to very distant places.

The other animals who come for the fig-party on my tree, including Dada, also carry away my seeds—and lo, through these animal friends my babies will find a place to grow! Have you ever seen a tiny Peepal sapling growing in the small space between two tiles on a footpath? Or from a little crevice of the wall of an old temple? Have you wondered how they got there? Now you know! And my seeds are special, they need very little soil to grow. Even a bit of moisture on, say, a window sill or a crack in the wall is enough for the seeds to take root and grow into new fig plants, and establish more secret gardens.

In nature, the links between species help sustain life. Besides its relationship with the Fig-wasp, the fig tree is also involved in another mutualism with fruit-eating animals. Animals derive nutrition from the fruits of fig trees and in return, help spread their seeds.

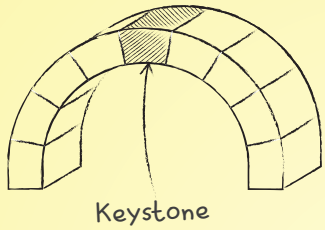
Keystone Species

We Peepals are very important for the food web. Whether it is summer or winter, you'll find us fruiting. So even when other trees don't bear fruits, we do. Animals and birds can depend upon us for fruits any time of the year. This holds true for my cousins too, other Ficus trees like the Banyan and the Goolar tree.

Many frugivorous species would find it hard to survive lean seasons without figs. And so, the loss of fig trees can lead to drastic declines in animal population. A decline in the population of frugivores such as hornbills can impact several other plants which depend on them for seed dispersal. And that is why fig trees are keystone species, since they are integral to the survival of the entire ecosystem.

Keystone species are those that play an unusually important role in the maintenance of ecosystems.

The word keystone is derived from the name given to the piece of stone that is placed at the apex of stone arches. The keystone supports the arch, and holds all the other stones in position. If the keystone is removed, the arch will collapse.



Keystone

So, child—you now know my story. Look around you—you'll see the Banyan, and the Goolar fig—we're all Ficus trees, and we all have our own special wasp friends, and our own stories.

Ah, now, if you'll excuse me, I see Kanaja's friends coming over, looking around for secret gardens. My brothers and sisters somewhere around have gardens ready for them, but I have to get around to making some new gardens, for the next few waspy friends of mine.

The Secret Garden

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